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RECOVERING URBAN RIVERS AND WATER STREAMS – DRENURBS/WATER SOURCES PROGRAM IN BELO HORIZONTE

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Hydric bodies were gradually degraded with the urban growth of many Brazilian cities. The highly rapid urbanization process of the 20th century unveils the absence of planning and disregards the physical and environmental aspects that exist in river basins. On the contrary, what is observed are rivers and water streams hidden in the urban landscape, both underground or behind buildings, most of them severely polluted and with their lowland areas densely occupied. All these characteristics contribute to the ever-constant problems of floods and disease proliferation, especially in rainy seasons.

Thus, recovering hydric resources has become an often-adopted public policy strategy, formulated towards the promotion of shared management of waters. In Brazil, the National Water Resources Policy is the main legislative and institutional landmark in te field (Sáchez e Jacobi, 2012), giving broad policy competences do subnational entities, especially municipalities. Therefore, municipalities became important agents in the management of water resources and the territorial locus where water bodies recovery policies are generally developed and implemented.

In Belo Horizonte, the Town Hall launched in 2001 the Program for Environmental Recovery and Sanitation of Valley Floors and of Creeks in Natural Beds (Drenurbs/Nascentes). The intention was to promote integrated and comprehensive actions of environmental management, urban planning and social inclusion in the areas surrounding polluted water resources with human settlements in the riverbanks. The program's main goal was (and still is) to improve vulnerable populations' quality of life through the full treatment of valley floors and thorough recovery of creeks and water streams that still run in their natural beds. Regarding more specific targets, the policy also aims at combatting floods, recovering urban rivers and creeks, and implementing a sustainable drainage system.

For this purpose, the program counts with several guidelines involving (i) the integrated treatment of sanitary problems in river basins; (ii) the pressure for putting limits to the expansion of ground sealing initiatives, mostly through the promotion of natural solution for water stream management; (iii) promotions of water stockage instead of rapid evacuation policies; (iv) the inclusion of water bodies in the urban landscape planning; (v) adoption of alternative techniques to the conventional procedures for drainage issues; and (iv), the inclusion and the participation in the policy process of all communities that may directly benefit from the Program's interventions and actions.

The program requires, for the development of all its actions, that the public administration institutions have a technical and scientific knowledge framework, as well as the development of good relationships with the selected communities. Thus, this work intends to understand what are the socio-technical transitions that made possible to Belo Horionte formulate and implement the Drenurbs/Nascentes Program, which gained national and world-wide recognition for its innovative character and successful results. Having this goal, the present research will approach the following issues:

- A brief history of the Program along its almost two decades of functioning and a highlight of what were its innovative characteristics that made it an international benchmarking case.
- The functioning of the socio-technical systems in Belo Horizonte for environmental recovery;
- The level of capabilities for managing innovations;
- The learning process and mechanisms to acquire the capability over time;
- The enabling or constraining factors to the learning process and to the final results.

Based on those needs, the empirical research has four dimensions of analysis, which will have to be carried out in each of the latter four specific items.

Dimension 1 - Mapping the socio-technical system

A sociotechnical system consists of a cluster of elements, including technology, regulation, user practices and markets, cultural meaning, infrastructure, maintenance networks, and supply networks (Geels, 2004). The scheme below (Figure 1) is an initial mapping of the socio-technical system for environmental recovery in Belo Horizonte.

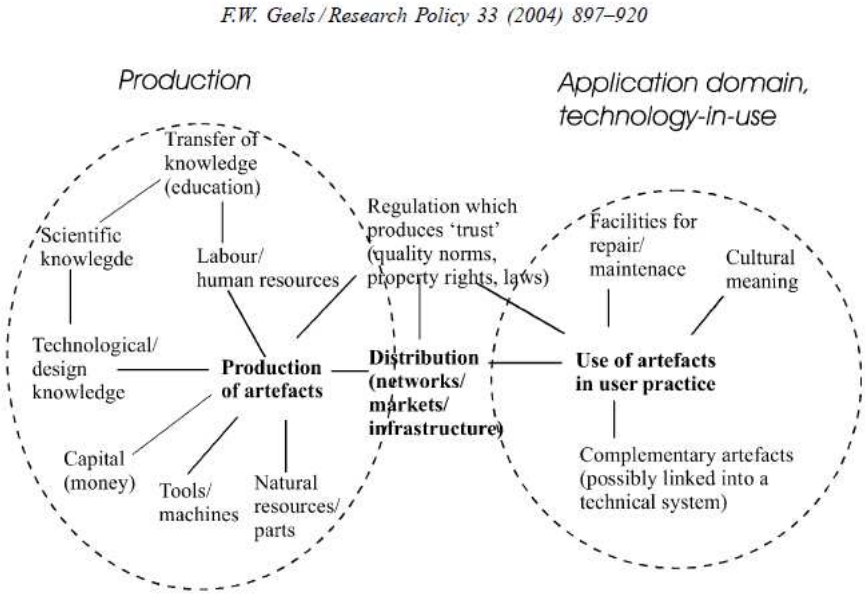

Fig. 1. The basic elements and resources of socio-technical systems.

The following points should be examined further in the DRENURBS case:

- Identify the scope and boundaries of the socio-technical system of the Drenurbs/Nascente case in Belo Horizonte (find in **ANNEX A** an initial draft of this mapping);
- Map the main parts and regimes of this socio-technical system both in the production and application (use) of environmental recovery in Belo Horizonte, such as the technologies used, regulation, user practices and markets, cultural meaning, infrastructure, maintenance networks, and supply networks (find in **ANNEX B** an initial draft of this mapping);
- Identify the main actors (particularly organizations) in each part of the system and how they interact with each other (find in **ANNEX C** an initial draft of this mapping);
- Describe how the socio-technical system for environmental recovery in Belo Horizonte changed over time, identifying the most important regime change that enabled that particular technological change to succeed.

Dimension 2 - Assessment of the level of capability of an innovation system

In order to assess the change that took place in the case of environmental recovery in Belo Horizonte, we will look at the innovation capabilities, which is the capability to carry out and manage different degrees of innovation and change. To analyse the innovation capabilities a scale of three levels will be used:

- ***Level 1 - Basic innovation*:** being able to introduce very minor technological changes in technologies which are mostly experience-based or reliant on the introduction of new vintages of technologies in the systems.
- ***Level 2 - Intermediate innovation*:** being able to introduce technological changes which are mostly adaptations to existing technologies, not formal R&D or creative experimentation.
- ***Level 3 - Advanced innovation*:** being able to introduce technological changes based on R&D close to the technological frontier, within an existing and established technological trajectory.

More specifically for the environmental recovery case in Belo Horizonte, we will analyze the capabilities to perform the following functions (Table 1):

Knowledge of sustainable urban drainage (SuDS) techniques:

- Who (one or more organizations in the city of beyond) has the knowledge about sustainable urban drainage techniques in the city related to the project Drenurbs/Nascentes?
- What level of knowledge they have regarding the main sustainable urban drainage available for intervention in the particular situation found throughout the city? How they work and what is the best technology for environmental recovery?

Socio-environmental and urban planning skills:

- Who (one or more organizations in the city of beyond) has the knowledge about socio-environmental and urban planning skills related to the program Drenurbs/Nascentes, able to develop and manage public work, minimizing negative impacts and maximizing the policy benefits?
- What level of knowledge they have regarding the best solutions for each municipal sub-basin based on socioenvironmental, urban and landscape aspects, in order to reforest/recover rivers and sub-basin?

Negotiation and managerial/operational skills :

- Who (one or more organizations in the city of beyond) has the knowledge in social communication to negotiate with citizens living in risk areas around streams or rivers, during an expropriation process?
- What level of knowledge they have related to how effectively mobilize citizens, develop trust, know how to manage with vulnerable social groups, promote the expropriation, indemnity and replacement process?

Table 1. Level of Capabilities and Functions for Belo Horizonte Drenurbs/Nascente Program

Levels of capabilities/ Functions	Sustainable Urban Drainage Techniques	Socio-environmental and urban planning skills	Negotiation and managerial/operational skills
Level 3 (Advance)	-Know very well the Sustainable Urban Drainage (SuDS) techniques available in the market and academia through experience or technical formation. A group of staff members or a department of the city government know the existing sustainable drainage technologies, how they work, how to operate and manage them and what is the best technology for the particular situations found throughout the city. - Know very well the sewage collection system techniques available in the market and academia to provide water treatment integrated with the drainage system. Expertise in sewage implementation system in the majority city area. - Thorough mapping of all water sources and small rivers in the city, both channeled and open rivers. A municipal, academic or state department that can provide a geo-referenced information system (SIG) to collect and gather the information, with which all the policy relies on to be carried out.	- Know very well the physical, biological and other natural characteristics of the water sources, rivers and sub-basins located within the city, important knowledge to operate the drainage and cleansing technologies. A group of experts and laboratories that can carry all analysis (production of Environmental Impact Study and Environmental Impact Report). - Deep knowledge of urban planning techniques, linked to environment protection knowledge – especially depollution technologies and urban construction methods. A group of experts that is able to develop and adapt specific socioenvironmental, urban and landscape solutions for each municipal sub-basin. - A group of experts with strong knowledge in environmental management capable to develop and manage public work, minimizing negative impacts and maximizing the policy benefits. - Knowledge and experience in other municipal interventions to protect and reforest/recover rivers and sub-basins.	- Know very well how to effectively negotiate with citizens living in risk areas around stream or rivers. A group of staff members or a department in the public sector with experience in expropriation process, indemnity, replacement and social assistance. - Know very well how to effectively mobilize citizens and organizations about the silting and pollution problems in streams or rivers. Have a comprehensive understanding of vulnerable social groups and their relation with their neighbor water sources. A group of staff members or a department in the public sector with expertise in social communication and street level bureaucracy; knowledge on how to develop trust among users. -True recognition by all stakeholders involved of the relationship between the processes of the natural and social worlds. The idea is paramount for supporting the government stakeholders commitment to the initiative. -Know very well project management techniques. A professional or group of public/project managers with expertise in project management and coordination of staff – especially given a context with an intersectoral policy with a wide range of different sector stakeholders (infrastructure, sanitation, social assistance, environment, health, among others).
Level 2 (Intermediary)	-Have good knowledge of SuDS techniques available in the market and academia through experience. A group of staff members or a department of the city government know the main drainage technologies, how they work and what is the best technology for that particular situation and city. - Expertise in sewage implementation system in partial city areas through public or private enterprise.	- Have good knowledge in physical, biological and other natural characteristics of the water sources, rivers and sub-basins located within the city, important to operate the drainage and cleansing technologies. A group of experts specialized in water analysis. - Knowledge and experience in urban planning techniques, linked to environment protection knowledge – especially depollution technologies and urban construction methods. A group of experts that is able to develop and adapt specific socioenvironmental, urban and landscape solutions for each municipal sub-basin.	- Have some experience in negotiation process with citizens living in risk areas. A group of staff members or a department in the city with a good idea mostly through experience of a different organization acting in expropriation, indemnity and replacement. - Have some experience in how to mobilize citizens and organizations about the silting and pollution problems in streams or rivers. A group of staff members or a department in the public sector with expertise in social communication and street level

	- Partial mapping of the water sources and small rivers in the city, both channeled and open rivers. A municipal, academic or state department that can provide an update geo-referenced information system (SIG) to collect and gather the information.	- A group of experts with knowledge in environmental management capable to develop and manage public work, minimizing negative impacts and maximizing the policy benefits. - Knowledge and experience in other municipal interventions to protect and reforest/recover degraded areas.	bureaucracy; knowledge on how to develop trust among users. -Know project management techniques. A professional or group of public/project managers with expertise in project management and coordination of staff – especially given a context with an intersectoral policy with a wide range of different sector stakeholders (infrastructure, sanitation, social assistance, environment, health, among others).
Level 1 (Basic)	-Know the basics of the drainage techniques. A group of staff members or a department of the city government know the basics of drainage techniques or have institutional partnerships. -Know the sewage collection system techniques available. Low expertise in sewage implementation system in partials city areas. - Partial mapping of water sources and small rivers in the city, both channeled and open rivers. A municipal, academic or state department that can provide an update geo-referenced information.	- Know the physical, biological and other natural characteristics of the water sources, rivers and sub-basins located within the city. A group of experts able to classify water analysis. - A group of staff members or a department of the city government have some basic experience in urban planning techniques, linked to environment protection knowledge, able to develop specific socioenvironmental, urban and landscape solutions for each municipal sub-basin. - A group of experts or organization with knowledge in environmental management capable to develop and manage public work, minimizing negative impacts and maximizing the policy benefits.	- Know the basics of negotiation process with citizens. A group of staff members in the public sector that know methods used by organizations in expropriation, indemnity and replacement. - Know techniques to mobilize citizens and organizations. Have experience acting with vulnerable social groups. A group of staff members or a department with social communication techniques and street level bureaucracy. - Know project management techniques. A professional or group of that know project management techniques.

Dimension 3 - Framework for assessing learning mechanisms

Learning here will be understood as the various mechanisms by which cities or organizations within a city build up and accumulate their innovative capabilities. The current level of technological capability assessed in the Dimension 2 evolved over time (the system in analysis did not have the current level of technological capability in the past). The organization and the system acquired this capability through different kinds of learning mechanisms. The focus of the study is the production side of the socio-technical system, but we will also address the "demand side" of the technology.

Based on the concept of learning used in the present project, and considering the research questions, the understanding and assessment of learning mechanisms should incorporate the identification of key processes or actions which evidences and essentially characterizes learning mechanisms that contribute towards specific events of technological change. Table 2 presents the framework for assessing learning mechanisms in cities. Learning mechanisms are differentiated according to two aspects: (i) the locus of the sources of learning; and (ii) the level of cognitive effort they involve.

Table 2. Framework for assessing learning mechanisms

(A) Direction of the Flow	(B) External learning mechanisms	(C) Internal learning mechanisms
2 Two-way knowledge flows	Interactions with foreign organizations	Knowledge codification
	Interactions with local universities and research institutes	Knowledge sharing/socialization
	Interaction with suppliers or consultants	Learning from formal experimentation
	Interaction with users	Learning from engineering and design experimentation
	Exchanges of knowledge with foreign organizations or other cities	
1 One-way knowledge flows	Hiring of expertise	Internal training
	Education and training programs	Learning from operational experimentation
	Learning from technical assistance and consulting services	Online manual or teaching material
	Learning from supply assistance	
	Learning through feedback from lead users	
	Searching into specialized knowledge sources	

Dimension 4 - Framework for assessing institutions for enabling changes

The institutional framework is understood here as the 'rules of the game' regulating the behaviour of organisations and individuals. In the analysis of the institutional framework we will adapt the model proposed by Scott (2001) and further developed by Geels (2004) defining institutions as composed by regulative, normative and cognitive dimensions, each generating different types of supporting incentives. The regulative dimension is based on rules, monitoring and sanctions; the normative dimension involves the establishment of prescriptive expectations about desired behaviours; finally, the cognitive dimension consists of shared conceptions about courses of action.

We will focus specifically on the different legal, administrative, political, cultural or economic that may have enabled or hindered the final results in terms of a particular initiative. We will refer to some factors identified in the literature (Van der Bergh et al., 2007, Table 4). We will look at intentionally designed interventions, i.e. regulations, laws, norms, policy guidelines, international cooperation programmes, governance changes (e.g., participation of the environmental agency in the transportation planning) which have an implicit or explicit objective to influence technology and social innovation efforts in the area of climate change and biodiversity. The regularities of behaviour embodied in policy guidelines, norms, regulations, rules, laws, standards, routines institute positive and negative incentives that may shape the technological behaviour of cities and sectors of the countries examined. Therefore, its results may impact positively, or not, the performance of organizations.

The study should identify through the interviews the main factors that enabled or disabled the use of capabilities to deliver innovations. Those factors should be based on

evidences from the fieldwork (interviews and if possible matched with field observation or triangulation with other interviews).

ASPECTOS GERAIS	Prioriza a reintegração dos cursos d'água à paisagem. Área de abrangência de 51% da área urbana, envolve 47 sub-bacias e contempla 45% da população total do município.
	O DRENURBS recebeu nomeação honrosa no Metropolis Awards em 2010
	200 km de cursos d'água. 177 km2 (54% área do município. População: 1.011.000 hab. 1a etapa - R$ 207 milhões (5 bacias hidrográficas)
CONTEXTUALIZAÇÃO	O DRENURBS é resultante do **Plano Diretor de Drenagem Urbana de Belo Horizonte (PDDU)** . Este foi dividido em duas etapas, sendo a primeira concluída em 2001 e a segunda em 2011.
O PROGRAMA	"tratamento integrado dos problemas sanitários e ambientais no nível da bacia hidrográfica". Adoção de calhas vegetadas (aumento da permeabilidade do solo); implantação de parques e de APP's ao longo dos cursos d'água; envolvimento das comunidades nos processos de decisão relativo à recuperação e à conservação.
METAS PRINCIPAIS	Despoluição de 140 km de cursos d'água, abrangendo 73 córregos e 47 bacias hidrográficas
	Redução dos riscos de inundações
	Controle da produção de sedimentos
	Integração dos recursos hídricos naturais ao cenário urbano
	Fortalecimento institucional da PBH
1a ETAPA	Intervenção em 5 sub-bacias. Destas, 4 foram concluídas até 2012.

ANNEX A: Scope and boundaries of the socio-technical system (working in progress)

ANNEX B: Main parts and regimes of this socio-technical system (working in progress)

EIXOS	Eixo 1 - OBRAS: - tratamento de fundo de vale - implantação de parques lineares - implantação de sistema de esgotamento sanitário - adequação do sistema viário - recuperação de nascentes - controle de cheias
	Eixo 2 - SOCIOAMBIENTAL: - programa de educação ambiental - plano de desapropriação - indenização e relocação de famílias e negócios afetados - plano de controle ambiental de obras - monitoramento da qualidade das águas

	- processo de licenciamento ambiental - plano de comunicação e mobilização social
	Eixo 3 - FORTALECIMENTO INSTITUCIONAL* - monitoramento da qualidade das águas - implantação de sistema de monitoramento hidrológico e alerta contra inundações - atualização e ampliação do SIG de drenagem - proposição de novo modelo de gestão pública das águas urbanas e permanente capacitação em drenagem *Corresponde à segunda fase do PDDU

ANNEX C: Stakeholders (working in progress)

STAKEHOLDERS	Lançado pela Secretaria Municipal de Política Urbana de Belo Horizonte
	Sustainable Water Management Improves Tomorrow's Cities Health (SWITCH)
	Superintendência de Desenvolvimento da Capital (SUDECAP)
	Pesquisadores dos Departamentos de Engenharia Hidráulica e Recursos Hídricos (HER) e de Engenharia Sanitária e Ambiental (DESA) da UFMG
	Banco Interamericano de Desenvolvimento (BID) como financiador
	Secretaria Municipal de Meio Ambiente
	Secretaria Municipal de Obras e Infraestrutura
	ICLEI Global
	Companhia Urbanizadora e de Habitação (URBEL)
	Companhia de Saneamento de Minas Gerais (COPASA)

INTERVIEW WITH RODRIGO PERPÉTUO (PRESIDENT OF ICLEI SOUTH AMERICA)– DRAFT

- ICLEI
  - apoiam tecnicamente as Prefeituras em acordos de PP transversais
  - lideres de futuro- universidades, protagonismo jovens
  - ICELI nasce em 1990, na onda da Rio-92, naquele momento focavam nas secretarias de meio ambiente.
  - apostam hoje na interlocução com os prefeitos.
  - Havia um projeto com a Unesco 36 cidades e 16 universidades. Projeto SWITCH , ele tinha o objetivo de consolidar no plano internacional a importância da água como planejamento urbano.
  - Sonia Knauer - técnica da Prefeitura q era um enlace da Prefeitura com o SWITCH isso ocorreu por volta de 2005.
  - Maria Caldas - Secretaria de Planejamento Urbano e tava na época na consolidação do projeto

- O BID entrou como negociação direta . Prefeitura era PT e federal era PSDB. O BID entra nesse cenário, com dificuldade. A visibilidade internacional do Projeto vem tb do financiamento do BID.
- houve algumas resistências por parte da pop. Mas o processo de participação foi eficaz, e já havia tradição nesse tipo de processo.
- Rodrigo ficou até 2015 na Prefeitura.
- O financiamento do BID foi em uma Bacia hidrográfica. Depois muda o contexto político, com um alinhamento do governo municipal com o federal.
- DE 2005 a 2008 o programa era uma grande ancora, e com o encerramento do BID, tira BH da cena que contribuía internacionalmente.
- Hoje em dia a inundação continua acontecendo e o problema é visto como segundo plano.
- BH tem três momentos distintos.
- de 93 a 96: vc tem uma administração vanguardista e cosmopolita. havia política de combate a fome , q serviu como referencia para outros países. BH nessa época olhou para o mundo. Com a Eco 92, a agenda da biodiversidade surgiu com vigor, e a Prefeitura de BH usava estas referencias como forma de agir. As políticas municipais estava repercutindo os acordos internacionais.
- A secretaria de relações internacionais surge nesse contexto. Trabalhar as políticas locais com as referências internacionais.
- Participação do ICLEI em BH entra em 1993, a participação do SWITCH, a relação com o BID em BH. Visita do Presidente. A secretaria ajudava nessa relação
- Vale a pena visitar o Programa Vila Viva - programa de urbanização de favelas da Prefeitura. Virou PAC da favelas depois.
- Na relação da Prefeitura com o BID, tem-se uma cultura enraizada de dialogo popular e social q carrega um conflito intrínseco, mas q a Prefeitura administrava mto bem. Os grupos da sociedades civil estavam inseridos nisso. No processo de financiamento teve idas e vindas, pq o empréstimo depende da oscilação do dólar, teve momentos de dúvidas de ir ou não com o financiamento BID.
- INTERACT Bio - projeto de biodiversidade. olha para o estatuto das metrópoles, olha pra ilha com serviços ecossistêmicos, PDUIs das áreas metropolitanas, inserem a perspectiva da biodiversidade. Fazem um diagnostico,

CONCLUSION

To be written.

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